

CLAIMS

1 1. A method for preventing passive release of interrupts within a computer sys-
2 tem, the computer system having at least one processor for servicing the interrupts, one or
3 more input/output (I/O) devices configured to issue interrupts, and an I/O bridge having a
4 plurality of ports to which I/O devices are coupled and configured to interface between
5 the I/O devices and the processor, the method comprising the steps of:

6 asserting an interrupt signal by a subject I/O device coupled to a given port of the
7 I/O bridge;

8 forwarding an interrupt message corresponding to the interrupt signal to the proc-
9 essor for servicing;

10 setting an interrupt pending flag in response to assertion of the interrupt signal;

11 in response to the interrupt being serviced, generating a first ordered message, the
12 first ordered message notifying the subject I/O device that the interrupt has been serviced;

13 generating a second ordered message for clearing the interrupt pending flag;

14 sending the first ordered message to the given port of the I/O bridge;

15 sending the second ordered message to the given port of the I/O bridge after the
16 first message has been sent;

17 deasserting the interrupt signal in response to the first message; and

18 clearing the interrupt pending flag at the interrupt file in response to the second
19 ordered message.

1 2. The method of claim 1 further comprising the step of forwarding the first or-
2 dered message from the given I/O bridge port to the subject I/O device.

1 3. The method of claim 2 wherein the step of deasserting the interrupt signal is
2 performed by the subject I/O device following its receipt of the first ordered message.

1 4. The method of claim 3 wherein the I/O bridge further includes an interrupt port
2 and the interrupt pending flag is disposed at the interrupt port, the method further com-

3 prising the step of forwarding the second ordered message from the given I/O bridge port
4 to the interrupt port.

1 5. The method of claim 4 wherein
2 the interrupt pending flag is implemented through a register of the interrupt port;
3 and
4 the second ordered message is a write transaction to the register for clearing the
5 interrupt pending flag.

1 6. The method of claim 5 further comprising the steps of:
2 periodically collecting a set of information regarding the assertion of interrupt
3 signals by I/O devices; and
4 after the step of clearing the interrupt pending flag, waiting a predetermined time
5 before collecting a next set of information regarding the assertion of interrupt signals.

1 7. The method of claim 6 wherein the step of periodically collecting is performed
2 through one or more serial data transfer operations.

1 8. The method of claim 1 wherein the steps of generating the first and second or-
2 dered messages are performed by the processor.

1 9. The method of claim 8 wherein the computer system includes (1) a plurality of
2 processors at least one of which is designated to service interrupts from the subject I/O
3 device, and (2) a plurality of I/O bridges each I/O bridge coupled to a plurality of I/O de-
4 vices configured to assert respective interrupt signals.

1 10. The method of claim 1 wherein the interrupt signals are level sensitive inter-
2 rupts (LSIs).

1 11. A computer system comprising:

2 a plurality of input/output (I/O) devices configured to assert and deassert respec-
3 tive interrupt signals;

4 at least one processor for servicing interrupts from the I/O devices; and
5 an I/O bridge configured to interface between the I/O devices and the at least one
6 processor, the I/O bridge having a plurality of ports to which the I/O devices are coupled
7 and an interrupt controller configured to detect the assertion and deassertion of the inter-
8 rupt signals, wherein

9 the interrupt controller, in response to assertion of an interrupt signal by a subject
10 I/O device coupled to a given I/O bridge port, issues an interrupt message to the proces-
11 sor and sets an interrupt pending flag;

12 the processor, upon servicing the interrupt, sends first and second ordered mes-
13 sages to the given port of the I/O bridge, the first ordered message notifying the subject
14 I/O device that the interrupt has been serviced, and the second ordered message clearing
15 the interrupt pending flag;

16 the subject I/O device deasserts the interrupt signal in response to the first mes-
17 sage; and

18 the interrupt pending flag is cleared in response to the second ordered message.

1 13. The computer system of claim 12 wherein

2 the I/O bridge further includes an interrupt port at which the interrupt controller is
3 disposed, and

4 the given port of the I/O bridge forwards the second ordered message to the inter-
5 rupt port after forwarding the first ordered message to the subject I/O device.

1 14. The computer system of claim 13 wherein the interrupt port of the I/O bridge
2 includes at least one register at which the interrupt pending flag is implemented.

1 15. The computer system of claim 12 wherein

2 the I/O bridge port includes a read cache for buffering messages received from the
3 at least one processor, and an ordering engine operatively coupled to a read cache, and

4 the ordering engine is configured to release ordered messages buffered in the read
5 cache in the same order as which they were received.

1 ¹⁶ The computer system of claim 12 further comprising an interrupt collector
2 having a parallel-load shift register for receiving the interrupt signals from the I/O de-
3 vices, the serial shift register configured to transfer information indicating the assertion or
4 deassertion of interrupt signals to the interrupt controller through one or more serial shift
5 operations.

1 ¹⁷ The computer system of claim 16 wherein
2 the interrupt collector transfers the information in response to a request from the
3 interrupt controller, and
4 the interrupt controller is configured to limit the number of serial shift operations
5 performed by the interrupt collector so as to receive only information associated with in-
6 terrupt signals that have been enabled.

1 ¹⁸ The computer system of claim 12 wherein the interrupt signals are level sen-
2 sitive interrupts (LSIs).